1″ less than this, and there is evidently sensible ellipticity to the orbit.

At present the satellite is assumed to be of the 13th magnitude. Under the most favourable conditions it has not been possible to see the shadow of this object when in transit. From these and other considerations the satellite is probably not over 100 miles in diameter. Taking everything into consideration the brightness at east and west elongations is the same.

Mount Hamilton:
1892 *October* 24.

P.S.—Following are two of the last observed *east elongations* of the satellite:—

1892.	d	h	m	
Oct.	21	17	2·8	G.M.T. computed from measures before and after elongation.
	23	16	49·0	" " " "

The measured distance at east elongation of the 23rd was—

62″·90

October 26.

On the Sidereal Period of the New Satellite of Jupiter. By the Rev. A. Freeman, M.A.

Upon examination of Professor E. E. Barnard's most important paper upon the "Discovery and Observation of a Fifth Satellite of Jupiter," published in No. 275 of the *Astronomical Journal*, for October 4, 1892, it seems probable that an error has been made in deducing the period from the concluded apparent distances of the satellite at its elongations, September 10, 12, and 14. Professor Barnard employs the formula—

$$P=p\sqrt{\frac{m}{M}\cdot\frac{R^3}{r^3}},$$

in which he states that m is the mass of the Earth, and M that of *Jupiter*, p and r the periodic time and geocentric radius of our Moon, P and R the periodic time and jovicentric radius of the new satellite. But, if he had desired to compare the period with that of our Moon, he ought to have employed the formula,

$$P=p\sqrt{\frac{m+m^1}{M+m_0}\cdot\frac{R^3}{r^3}},$$

in which $m^1=\frac{1}{81}m$ (nearly) is the mass of the Moon, and m_0 is the mass of the new satellite, so small as to be neglected in comparison with the mass of *Jupiter*. Unless, therefore, the "*mass of the Earth*" meant by Mr. Barnard includes that of the Moon also, his resulting period is manifestly and decidedly too small.

I prefer to compare the motion of the new satellite with that of the first hitherto known satellite of *Jupiter*.

The exact formula to be employed is

$$\frac{P}{P_1} = \sqrt{\frac{M + m_1}{M + m_0} \cdot \frac{R^3}{R_1^3}},$$

where M is the mass of *Jupiter*, m_0 and m_1 the masses of the new and first satellites, R and R_1 their jovicentric radii. We can, however, safely neglect the masses of both satellites, and use the simple expression—

$$P = P_1 \left(\frac{R}{R_1}\right)^{\frac{3}{2}}.$$

From Barnard's apparent elongations, September 10, 12, 14, viz.: $61''\cdot04$, $61''\cdot55$, $61''\cdot50$, which correspond to G.M.T. $20^h\ 53^m$, $20^h\ 38^m$, $20^h\ 24^m$ (with sufficient accuracy), on the respective dates, I find by multiplying the apparent elongations in seconds of arc by the concluded geocentric radii of *Jupiter*, taken from the *Nautical Almanac*, and dividing by 5·202800, the heliocentric mean radius of *Jupiter*, that $47''\cdot9613$, $48''\cdot1666$, $48''\cdot0217$ are the corresponding elongations of the new satellite as viewed from the Sun at the mean distance of *Jupiter* on September 10, 12, 14. The mean of these three is $48''\cdot04993$.

Now Bessel and Schur have given $111''\cdot7360$ and $111''\cdot6523$ for the mean elongation of Sat. I. of ♃, at ♃'s mean distance from the Sun. The mean of these two measures is $111''\cdot6942$. Moreover, the mean sidereal period of Sat. I. is 1·7691378 mean solar days. Hence we have

$$P = \left(\frac{48\cdot04993}{111\cdot6942}\right)^{\frac{3}{2}} \cdot 1^d\cdot7691378,$$

whence

$$P = 0^d\cdot4991775$$
$$= 11^h\ 58^m\ 48^s\cdot9$$

as the sidereal period of the new satellite. It is remarkable that this differs little from $11^h\ 59^m$, the period which is accepted by Mr. S. W. Burnham in a communication to the *Chicago Academy of Sciences*, at their meeting, 1892 October 4. (See *Observatory*, 1892 November.)

Further measures of elongation distances will no doubt soon be published by Mr. Barnard, and may be used to correct the period found above.

Murston Rectory:
1892 *November* 9.

Addendum.

Taking the necessary data from Professor W. Harkness's *The Solar Parallax and the Related Constants*, and employing the second formula in the foregoing paper, I find—

$$\frac{P}{27^{d}\cdot 32166116} = \left(\frac{1047\cdot 55}{327214}\right)^{\frac{1}{2}}\left(\frac{5\cdot 2028 \times 92796950 \times \sin 48''\cdot 05}{238854\cdot 75}\right)^{\frac{3}{2}}$$

$$= 0\cdot 5002246 \text{ days}$$

$$= 12^{h}\ 0^{m}\ 13^{s}\cdot 4.$$

An error of even $\frac{1}{20}$th of a second of arc in the assumed distance 48″·05 makes an appreciable difference in the resulting period. The best way of obtaining the true result is to infer it from the number of revolutions and parts of a revolution made by the satellite between the times of two distant elongations, as has now been done by Mr. A. Marth and Professor Barnard, whose periods thereby derived agree within half a second of time. The period found by Mr. Marth is $11^{h}\ 57^{m}\cdot 33$.

1892 *November* 15.

Enlarged Star and Moon Photographs. By H. C. Russell, B.A., F.R.S.

In making another enlargement of the photograph of the stars and nebulæ about *η Argûs* to replace the one destroyed in transit, it seems desirable to make it upon the same scale as Herschel's beautiful picture of that object published in the Cape observations, thus ensuring convenient comparison. This involved enlarging the original photograph, the scale of which is 2·3 ins. to 1°, up to 15 ins. to 1°, and the result is a strong testimony to the quality of the original negative. I have sent both positive and negative on paper. The paper negative of course involved making a positive by contact printing, in which much detail is lost. A comparison of these photographic enlargements with Herschel's drawing is very suggestive, both in regard to the difference in delineation and extent of the nebula by the eye and the sensitive plate, particularly in the great mass of detail which the camera brings out in the denser parts, and also the vastly greater number of stars, probably ten times as many in the photograph as in the drawing. (The original negative was exposed 5¾ hours.) I send also an enlargement of the same object (*η Argûs*) from a negative taken with a 6-inch diameter Dallmeyer portrait lens, and 8 hours exposure, on a scale of 0·556 in. = 1°, enlarged to 3 ins. = 1°. This enormously extends the area of the nebula, and shows that the dark markings which begin at the centre of the mass extend in curiously meandering lines to great distances, in several places enclosing nearly circular spaces. Looking at this photograph the nebula seems to spread out almost without limit, as indicated by the dark lanes which bring it into prominence; but the more definite parts, about which the connection with the central mass cannot be doubted, cover a space measured by 2° in R.A. and 3° in Decl., while the photograph taken with the star camera and 5¾ hours'